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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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09/807,515

04/16/2001

David C Herbert

124-850

9176

23117

7590

03/19/2003

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EXAMINER

KANG, DONGHEE

ART UNIT

PAPER NUMBER

2811

DATE MAILED: 03/19/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/807,515

Applicant(s)

HERBERT ET AL.

Examiner

Donghee Kang

Art Unit

2811

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 30 December 2002.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-19 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-19 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Acknowledgment

1. Applicant's Amendment and Response to Paper No.3 has been entered and made of Record. Claims 1-19 are pending in this application.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3. Claims **1-8, 10, & 13-15** are rejected under 35 U.S.C. 102(b) as being anticipated by Meng et al. (US 5,466,965).

Regarding claim **1**, Meng et al. teach an impact ionization avalanche transit time (IMPATT) diode device comprising (Fig.1):

a main avalanche region (18, AlGaAs) and a drift region (20), characterized in that the device additionally comprises a narrow bandgap (16, GaAs) with a band narrower than the bandgap in the main avalanche region which narrow bandgap region is located adjacent to the main avalanche region in order to generate within the narrow bandgap region a tunnel which is injected into the main avalanche region (Col.3, line 14-Col.6, line 45).

Regarding claim **2**, Meng et al. teach the narrow bandgap region is arranged to generate a tunnel current for injection into the main avalanche region at the peak reverse bias voltage applied to the diode.

Regarding claim 3, Meng et al. teach the narrow bandgap region is located at the edge of the main avalanche region.

Regarding claim 4, Meng et al. teach the narrow bandgap region is located between a heavily doped contact region (24) and the main avalanche region.

Regarding claim 5, Meng et al. teach the narrow bandgap region comprising one layer of narrow bandgap material.

Regarding claim 6, Meng et al. teach the narrow bandgap region comprising a plurality of layers of narrow bandgap material.

Regarding claim 7, Meng et al. teach the diode has a lo-hi-lo doping profile.

Regarding claim 8, Meng et al. teach the diode is a p-i-n diode.

Regarding claim 10, Meng et al. teach the diode is made of III-V semiconductor materials.

Regarding claim 13, Meng et al. teach the narrow bandgap region is made of at least one layer of Gallium Arsenide and the main avalanche region is made of aluminum gallium arsenide.

Regarding claims 14-15, Meng et al. teach the length of the drift region is between 2 and 6 times the length of the avalanche region (Col.3, line50-Col.4, line 15).

Regarding claim 16, Meng et al. teach the IMPATT diode arranged such that at least part of the tunnel current can be generated by optical excitation.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

Art Unit: 2811

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims **9, 11-12** are rejected under 35 U.S.C. 103(a) as being unpatentable over Meng et al. (US 5,466,965) in view of Mishra et al. (Design optimization of a single-sided Si/SiGe heterostructure mixed tunneling avalanche transit time double drift region, Semiconductor Sci. Tec. 12, 1997).

Regarding claim **9**, Meng et al. do not teach the diode is a double drift diode. However, Mishra et al. teach IMPATT diode having double drift regions to obtain better mm wave properties and lower noise. It would have been obvious to one of ordinary skill in the art at the time the invention was made to form double drift diode instead of single drift diode in Meng's device since the double drift diode structure has better mm wave properties and lower noise.

Regarding claims **11 & 12**, Meng et al. do not teach the diode is made of group IV semiconductor materials. Mishra et al. teach an IMPATT diode comprising Si/SiGe heterostructure. It would have been obvious to one of ordinary skill in the art at the time the invention was made to make IMPATT diode using Si/SiGe, since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as matter of obvious design choice. In re Leshin, 125 USPQ 416.

6. Claims **17-19** are rejected under 35 U.S.C. 103(a) as being unpatentable over Meng et al. (US 5,466,965).

Meng et al. teach the step of optically exiting at least part of the tunnel current. However, Meng et al. do not expressly teach an oscillating voltage across the diode having a period of between 4 and 12 times the transit time of the avalanche region. The microwave as well as noise properties of this diode can be improved by optimization of the width and/or applying oscillating voltage. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to vary the oscillating voltage in Meng's device in order to obtain a desired device.

Response to Arguments

7. Applicant's arguments filed 30 December 2002 have been fully considered but they are not persuasive. Applicant argues that Meng fails to teach the avalanche region and narrow bandgap region. This is not convincing. Meng et al. teach that AlGaAs layer 18 is an avalanche region (Col.4, line 53-56) and narrow band gap region 16 generates a tunnel current (Fig.1).

Conclusion

8. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of

the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Donghee Kang whose telephone number is 703-305-9147. The examiner can normally be reached on Monday through Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Thomas can be reached on 703-308-2772. The fax phone numbers for the organization where this application or proceeding is assigned are 703-308-7722 for regular communications and 703-308-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

dhk
March 10, 2003

A handwritten signature in cursive script, appearing to read "Steve Loh".